## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

## (19) World Intellectual Property Organization International Bureau





(43) International Publication Date 8 July 2004 (08.07.2004)

PCT

## (10) International Publication Number WO 2004/057053 A3

(51) International Patent Classification<sup>7</sup>: 16/54

C23C 14/56,

(21) International Application Number:

PCT/EP2003/014810

(22) International Filing Date:

22 December 2003 (22.12.2003)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data: PCT/IT02/00823

23 December 2002 (23.12.2002) IT

- (71) Applicant (for all designated States except US): PIRELLI PNEUMATICI S.P.A. [IT/IT]; Viale Sarca, 222, I-20126 Milano (IT).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): PAVAN, Federico [IT/IT]; Via Pilati, 4/a, I-50136 Firenze (IT). AGRESTI, Simone [IT/IT]; Via F. Ferrucci, 274, I-50047 Prato (IT). CAVALLOTTI, Pietro, Luigi [IT/IT]; Viale Abruzzi, 72, I-20131 Milano (IT). NOBILI, Luca [IT/IT]; Via Marzabotto, 27, I-20100 Milano (IT).

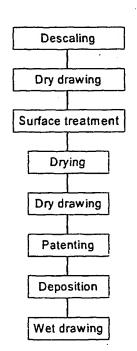
- (74) Agents: BOTTERO, Claudio et al.; Porta, Checcacci & Associati S.p.A., Via Trebbia, 20, I-20126 Milano (IT).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

## Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report: 5 August 2004

[Continued on next page]

(54) Title: METHODS FOR PRODUCING COATED METAL WIRE



(57) Abstract: A method for producing a metal wire for reinforcing an elastomeric material as well as a metal wire and a metal cord for reinforcing such an elastomeric material are described. The metal wire comprises a metal core having a predetermined initial diameter and a metal coating layer. The method comprises the steps of: a) submitting the core to at least one surface treatment for predisposing the surface of the core to being coated with the coating layer, b) thermally treating the core; c) depositing the metal coating layer to a predetermined initial thickness on the core by means of a plasma deposition technique; and d) drawing the coated core until the core has a final diameter smaller than said predetermined initial diameter and the metal coating layer has a final thickness smaller than said predetermined initial thickness. Advantageously, it is possible to obtain a wire coated in a uniform and homogeneous manner, including a core having a smooth surface suitable for the deposition of the coating layer and a structure suitable for the cold deformation involved in the drawing step.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.



Into ional Application No
PCT/EP 03/14810

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 C23C14/56 C23C16/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

 $\begin{array}{lll} \mbox{Minimum documentation searched} & \mbox{(classification system followed by classification symbols)} \\ \mbox{IPC 7} & \mbox{C23C} & \mbox{B32B} & \mbox{B29H} \end{array}$ 

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

Category* Citation of document, with indication, where appropriate, of the relevant passages  Relevant to ctain  X US 5 219 668 A (LIEVENS HUGO ET AL) 15 June 1993 (1993–06–15) 16 June 1993 (1993–06–15) 17 Level of the whole document 18 Level of the whole document 19 Level of th	C DOCUM	ENTS CONSIDERED TO BE RELEVANT		
The whole document 1-28  EP 0 241 721 A (SUMITOMO ELECTRIC INDUSTRIES) 21 October 1987 (1987-10-21) column 3, line 46 - column 4, line 50  US 3 055 089 A (DRUMMOND FOLSOM E) 4-7  25 September 1962 (1962-09-25) column 5, line 62 - column 6, line 3  EP 0 669 409 A (PIRELLI) 30 August 1995 (1995-08-30) page 3, line 24 - page 4, line 49  —/—  Further documents are listed in the continuation of box C.  Special categories of cited documents:  "Y document defining the general state of the an which is not considered to be of particular relevance on a first the international filling size of the categories of cited document but published on or after the international filling size of the categories of cited to establish the publication date of another citation or other special reason (as specified) or document defining the policial or other special reason (as specified) or document elerting to an oral disclosure, use, exhibition or other special reason (as specified) or document filling date but lister than the priority date claimed filling date but lister than the priority date claimed and the comment of particular relevance; the claimed invention cannot be considered novel or cannot be considered in over or more other such document is combined with one or more other such document is combined with one or more other such document; such combination being obvious to a person skilled in the art.  2 June 2004  Date of mailing of the international search 1-2 June 2004  Authorized officer  EV document member of the same patent family 2-1 June 2004  Authorized officer  EVENT A STATE OF THE STATE		<del>/ ''' </del>	e relevant passages	Relevant to daim No.
the whole document  EP 0 241 721 A (SUMITOMO ELECTRIC INDUSTRIES) 21 October 1987 (1987–10–21) column 3, line 46 – column 4, line 50  US 3 055 089 A (DRUMMOND FOLSOM E) 25 September 1962 (1962–09–25) column 5, line 62 – column 6, line 3  EP 0 669 409 A (PRELLI) 30 August 1995 (1995–08–30) page 3, line 24 – page 4, line 49  —/—   X Further documents are listed in the continuation of box C.    X Patent family members are listed in annex.   Yournent defining the general state of the an which is not considered to be of paticular relevance:		US 5 219 668 A (LIEVENS HUGO E	T AL)	29-31
INDUSTRIES) 21 October 1987 (1987–10–21) column 3, line 46 - column 4, line 50  US 3 055 089 A (DRUMMOND FOLSOM E) 25 September 1962 (1962–09–25) column 5, line 62 - column 6, line 3  EP 0 669 409 A (PIRELLI) 30 August 1995 (1995–08–30) page 3, line 24 - page 4, line 49  —/—   X Patent family members are listed in annex.  Special categories of clied documents:  document defining the general state of the ant which is not considered to be of particular relevance in a specified or document but published on or after the international filing date  document defining the general state of the ant which is not considered to be of particular relevance in the international filing date  document but published on or after the international filing date or priority date and not in conflict with the application but clied to understand the principle or theory underlying the considered to be of particular relevance; the claimed invention cannot be considered noted or cannot be considered noted to considered note of the release of the second particular relevance; the claimed invention cannot be considered to involve an inventive step when the occument be considered noted or cannot be considered in the cannot be considered in the considered in the cannot be considered to moder relevance; the claimed invention cannot be considered to involve an inventive step when the ments, such combination being obvious to a person skilled in the art.  '& document of particular relevance; the claimed in the art.  '& document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the ments, such combination being obvious to a person skilled in the art.  '& document of particular relevance; the claimed invention cannot be considered to finovitie an inventive step when the ments, such combination being obvious to a person skilled in the art.  '& document of particular relevance; the claimed in the art.  '& document of particular relevance; the claimed invention cannot be considered to involve an inventi	•			1-28
25 September 1962 (1962–09–25) column 5, line 62 - column 6, line 3  EP 0 669 409 A (PIRELLI) 30 August 1995 (1995–08–30) page 3, line 24 - page 4, line 49  -/  X Patent family members are listed in annex.  Special categories of cited documents:  A document defiling the general state of the an which is not considered to be of particular relevance are listed to underlying the desired document but published on or after the international filing date or which is cited to establish the publication date of another diation or other special reason (as specified)  Cocument referring to an oral disclosure, use, exhibition or other means  Cocument published prior to the international filing date but later than the priority date admined or more other special reason (as specified)  Cocument published prior to the international filing date but later than the priority date and not in conflict with the application but cited to underlying the invention  Cocument referring to an oral disclosure, use, exhibition or other special reason (as specified)  Cocument published prior to the international filing date but later than the priority date and not in conflict with the application but cited to unstitute the priority date and not in conflict with the application but cited to underlying the invention  Cocument of particular relevance; the claimed invention cannot be considered to common the considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.  2 June 2004  Authorized officer  Authorized officer  Authorized officer	ľ	INDUSTRIES) 21 October 1987 (19	1-28	
30 August 1995 (1995–08–30) page 3, line 24 – page 4, line 49  -/  X Further documents are listed in the continuation of box C.  Special categories of cited documents:  A' document defining the general state of the art which is not considered to be of particular relevance  E' earlier document but published on or after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention cannot be considered novel or can	<b>'</b>	25 September 1962 (1962-09-25)	4-7	
Special categories of cited documents:  A' document defining the general state of the art which is not considered to be of particular relevance  E' earlier document but published on or after the international filing date  C' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another clation or other special reason (as specified)  O' document referring to an oral disclosure, use, exhibition or other means  P' document published prior to the international filing date but later than the priority date cairned  2 June 2004  Date of the actual completion of the ISA  European Patent Office, P.B. 5818 Patentlaan 2  NL - 2280 HV Rijswijk  Tel. (+31-70) 340-2040, Tx. 31 651 epo ni,	Y	30 August 1995 (1995-08-30)	49 ·	29-31
Special categories of cited documents:  A' document defining the general state of the art which is not considered to be of particular relevance  E' earlier document but published on or after the international filing date  I' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  O' document referring to an oral disclosure, use, exhibition or other means  P' document published prior to the international filing date but later than the priority date claimed  attended in the art.  2 June 2004  T' later document published after the International filing date or priority date and not in conflict with the application but cited to understand the prioriple or theory underlying the invention of document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.  '&' document member of the same patent family  Date of mailing of the international search report  09/06/2004  Authorized officer  European Patent Office, P.B. 5818 Patentlaan 2 NL = 2280 HV Rijswijk Tet. (+31-70) 340-2040, Tx. 31 651 epo ni,	X Furth	ner documents are listed in the continuation of box C.	Y Patent family members are listed	in annex.
A' document defining the general state of the art which is not considered to be of particular relevance  earlier document but published on or after the international filing date  document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another clation or other special reason (as specified)  document referring to an oral disclosure, use, exhibition or other means  document published prior to the international filing date but later than the priority date claimed  2 June 2004  The later document published after the International filing date and not in conflict with the application but cited to understand the principle or theory underlying the invention cannot be considered novel or cannot be considered to involve an inventive step when the document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.  '&' document member of the same patent family  Date of mailing of the international search report  09/06/2004  Authorized officer  Authorized officer	Special ca	tegories of cited documents ;		
L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another claimon or other special reason (as specified)  O' document referring to an oral disclosure, use, exhibition or other means  P' document published prior to the international filing date but later than the priority date claimed  2 June 2004  Date of the actual completion of the international search  European Patent Office, P.B. 5818 Patentlaan 2  NL - 2280 HV Rijswijk  Tet. (+31-70) 340-2040, Tx. 31 651 epo nt,	consid E° earlier o	ered to be of particular relevance tocument but published on or after the international	or priority date and not in conflict with cited to understand the principle or th invention  "X" document of particular relevance; the of	the application but early underlying the claimed invention
later than the priority date claimed  ** document member of the same patent family  Date of the actual completion of the international search  2 June 2004  Date of mailing of the international search report  09/06/2004  Date of mailing of the international search report  Authorized officer  European Patent Office, P.B. 5818 Patentlaan 2  NL - 2280 HV Rijswijk  Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,	L* docume which clation O* docume	nt which may throw doubts on priority claim(s) or is ciled to establish the publication date of another or or other special reason (as specified) entrefering to an oral disclosure, use, exhibition or	involve an inventive step when the do "Y" document of particular relevance; the o cannot be considered to involve an in document is combined with one or may	ocument is taken alone claimed invention eventive step when the ore other such docu—
2 June 2004 09/06/2004  Jame and mailing address of the ISA Authorized officer  European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx. 31 651 epo nl,	P* docume later th	nt published prior to the international filing date but an the priority date claimed		family
Authorized officer  European Patent Office, P.B. 5818 Patentlaan 2  NL – 2280 HV Rijswijk  Tel. (+31-70) 340–2040, Tx. 31 651 epo nl,	ate of the a	actual completion of the international search	Date of mailing of the international sea	rich report
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo ni,	. 2	June 2004	09/06/2004	
Tel. (+31-70) 340-2040, Tx. 31 651 epo ni,	lame and n	European Patent Office, P.B. 5818 Patentlaan 2	Authorized officer	
		Tel. (+31-70) 340-2040, Tx. 31 651 epo ni,	Ekhult, H	



Instaltional Application No
PCT/EP 03/14810

<del></del>	N. D. D. C. L.	PCT/EP 03/14810
	Citation of document with larger	
Category •	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Υ .	US 5 403 419 A (YOSHIKAWA MASATO ET AL) 4 April 1995 (1995-04-04) cited in the application column 3, line 50 - column 6, line 34	29-31
Α	US 4 988 552 A (TOMALIN DANDRIDGE S) 29 January 1991 (1991-01-29) column 3, line 59 - column 4, line 42	1-31
<b>A</b>	US 4 725 340 A (DE FILIPPO DOMENICO ET AL) 16 February 1988 (1988-02-16) column 6, line 32 - column 7, line 63	. 1–31
A	EP 0 265 992 A (BEKAERT SA NV) 4 May 1988 (1988-05-04) column 1, line 34 - column 2, line 25	1-31
	·	
	· ·	
		·
		·
	·	
		·



Information on patent family members

In ational Application No PCT/EP 03/14810

		<del></del>			03/ 14810
Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 5219668	A	15-06-1993	NL AT CA DE DE EP JP	8602759 A 79653 T 1322987 C 3781245 D1 3781245 T2 0269144 A1 63157865 A	16-05-1988 15-09-1992 12-10-1993 24-09-1992 04-03-1993 01-06-1988 30-06-1988
EP 0241721		21 10 1007	US 	5057199 A	15-10-1991
Er U241/21	A	21-10-1987	JP JP JP JP JP DE	62220237 A 1946912 C 6073250 B 62287511 A 7095553 B 62287633 A 3781822 D1	28-09-1987 10-07-1995 14-09-1994 14-12-1987 11-10-1995 14-12-1987 29-10-1992
			DE EP KR US US	3781822 T2 0241721 A1 9007567 B1 4815309 A 4859811 A	07-01-1993 21-10-1987 15-10-1990 28-03-1989 22-08-1989
US 3055089	A	25-09-1962	CH DE FR GB	379869 A 1289616 B 1222618 A 891725 A	15-07-1964 20-02-1969 10-06-1960 21-03-1962
EP 0669409	А	30-08-1995	IT AU AU BR CA CN DE DE EP	1273334 B 167528 T 704718 B2 1236195 A 9500892 A 2143354 A1 1109923 A ,B 69502975 D1 69502975 T2 0669409 A1	08-07-1997 15-07-1998 29-04-1999 31-08-1995 12-09-1995 25-08-1995 11-10-1995 23-07-1998 11-02-1999 30-08-1995
			ES JP JP TR US US	2120087 T3 3421462 B2 7331480 A 28803 A 5722039 A 6059951 A	16-10-1998 30-06-2003 19-12-1995 25-03-1997 24-02-1998 09-05-2000
US 5403419	Α	04-04-1995	JP JP JP DE US JP	62087311 A 1861203 C 5080500 B 62087310 A 3635121 A1 4872932 A 2512912 B2 62189117 A	21-04-1987 08-08-1994 09-11-1993 21-04-1987 16-04-1987 10-10-1989 03-07-1996 18-08-1987
US 4988552	A	29-01-1991	JP WO	3501101 T 8912523 A1	14-03-1991 28-12-1989
US 4725340	Α	16-02-1988	EP AT	0253942 A1 62026 T	27-01-1988 15-04-1991



Intelligional Application No PCT/EP 03/14810

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 4725340	Α		DE	3678440 D1	02-05-1991
EP 0265992	A	04-05-1988	NL AT CA DE EP ES JP JP US	8602659 A 72585 T 1304430 C 3776681 D1 0265992 A1 2030051 T3 2521775 B2 63179068 A 4790165 A	16-05-1988 15-02-1992 30-06-1992 26-03-1992 04-05-1988 16-10-1992 07-08-1996 23-07-1988 13-12-1988